

MODIS—VIIRS Snow Cover Products Continuity

George Riggs* and Dorothy Hall**

MODIS/VIIRS Science Team Meeting, 1-4 May 2023, College Park, Maryland

*george.a.riggs@nasa.gov **dkhall1@umd.edu

Introduction

The objective of the analysis was to evaluate continuity among the MODIS and VIIRS snow cover data products to determine if they provide a snow cover extent data record suitable for research on snow cover climatology e.g., snow cover duration, and snow cover start and end dates.

Data Products and Method.

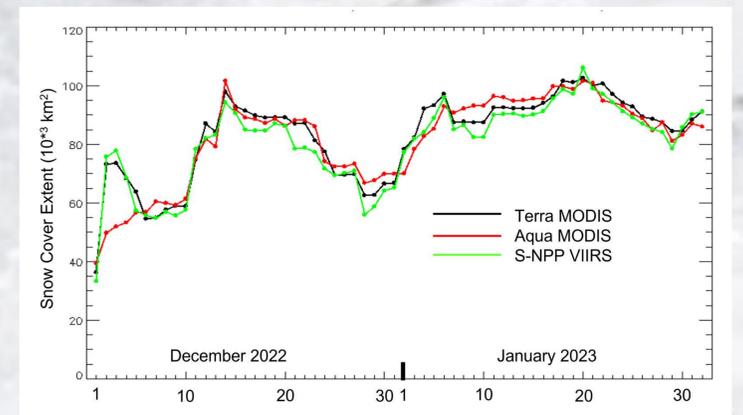
Three regions were studied, 1) the Northwestern US, 1–11 March 2021, 2) the Sierra Nevada region 1 December 2022–31 January 2023, and 3) the Buffalo, NY, US region 1 December 2022–31 January 2023. Comparisons of snow cover extent (SCE) among the MODIS Terra and Aqua, and VIIRS SNPP and JPSS1 daily cloud-gap-filled (CGF) products MOD10A1F, MYD10A1F, VNP10A1F, and VJ110A1F, respectively were done. The MODIS and VIIRS CGF products provide a daily “cloud free” view of SCE.

The NDSI snow cover data layer in a product was converted to binary SCE by defining snow cover as an NDSI snow cover value in the 10–100 data range. Snow cover extent is the total area of SCE observed on a day, calculated as the number of cells with snow cover multiplied by cell area.

Sierra Nevada Region



The Sierra Nevada study region is a 244,530 km² study area that includes the Sierra Nevada mountain range, and part of the intermountain region in the western United States. Geographic projection with 500 m grid cell resolution.

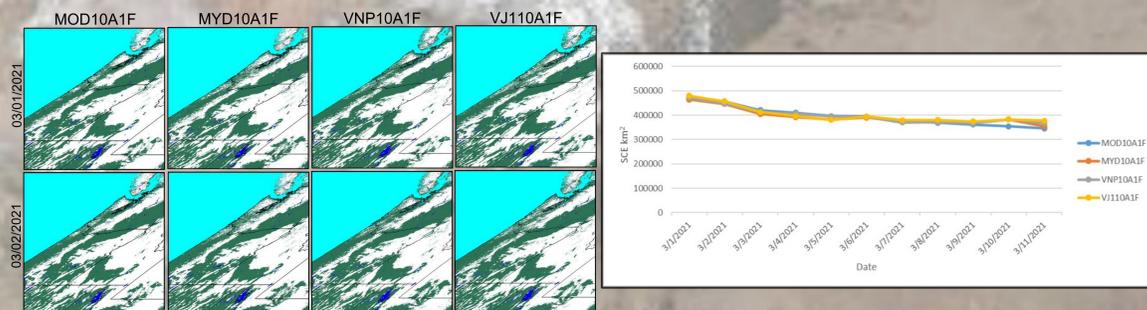


Comparison of daily SCE area among the CGF Terra MOD10A1F, MYD10A1F, and VNP10A1F, from 1 December 2022–31 January 2023. Individual plots show results from the Terra MODIS cloud-gap filled (CGF) SCE product, MOD10A1F, the Aqua MODIS CGF SCE product, MYD10A1F, and the S-NPP VIIRS CGF SCE product, VNP10A1F.

Between 1 December 2022 and 31 January 2023, there were days with clear views of the surface interspersed with days of cloud cover in the region. We think that the cloud-gap filled SCE products are adequately representing the changing snow conditions in this Sierra Nevada region study area. In the beginning of the time series, from 1-4 December there was an overnight snow event 1-2 December that deposited snow on the mountains and valleys. It is likely that the more conservative Aqua cloud mask erroneously mapped much of that snow as cloud thus snow was not mapped by Aqua and subsequent days of cloud cover over the region interfered with a return to close agreement in SCE among the three products. The Terra MODIS and NPP VIIRS data products did not have that same problem with the cloud masking and thus mapped snow from 1-4 December.

Northwestern US

The SCE maps among the MOD10A1F, MYD10A1F, VNP10A1F, and VJ110A1F products are very similar region over 1–11 March 2021. Large differences or inconsistencies in SCE among the four SCE products are not visually apparent in the SCE maps 1-2 March 2021, days with lesser cloud cover, and the SCE areas are very similar over the period of 1–11 March. There were no snow events during this time period thus the SCE area is nearly constant day-to-day with a gradual decrease over time which is attributable to snow cover ablation.



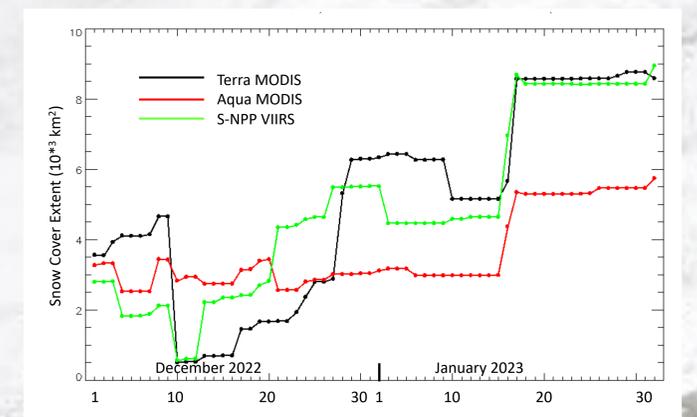
Comparison of SCE among MOD10A1F, MYD10A1F, VNP10A1F, and VJ110A1F, 1–2 March 2021. Snow cover is shown in white. The SCE maps are for tile H09V04, in sinusoidal projection, covering the northwestern US. The MODIS maps are 463 m resolution and the VIIRS maps are 370 m resolution.

SCE area comparisons among the CGF MOD10A1F, MYD10A1F, VNP10A1F, and VJ110A1F from 1–11 March 2021.

Buffalo, NY Region



The Buffalo study region is a 13,306 km² study area in western New York, US. Geographic projection with 50 m grid cell resolution.



Comparison of SCE among the CGF Terra MODIS MOD10A1F, Aqua MODIS MYD10A1F, and SNPP VIIRS VNP10A1F from 1 December 2022–31 January 2023.

Lake effect snow events occur frequently in this region and cloud cover conditions can change between the morning and afternoon satellite overpasses. Between 1 December 2022 and 31 January 2023, there were very few clear views of the surface. Additionally, a few lake effect snowstorms and ablation events occurred thus we do not expect that the CGF SCE products can adequately capture the rapidly-changing snow conditions in this area of western New York state at this time of year.